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STAR Clutter Image Analysis and Enhancements Final Report

Call-Up Against the Noise Monitoring Standing Offer

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Defence R&D Canada – Atlantic

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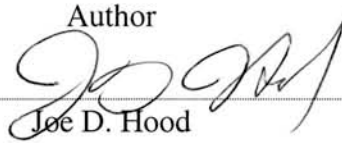Suite 60, 100 Windmill Rd.
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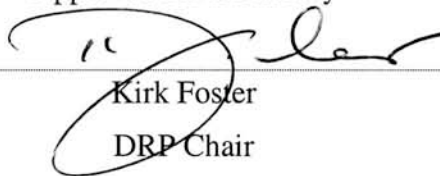
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Kirk Foster

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Abstract

This report documents the work done to aid in the generation and analysis of clutter images derived from Run 11 and Run 18 of TMAST02. This work included providing small enhancements to the existing Interactive Data Language (IDL)-based Software Tools for Analysis and Research (STAR) software, based on recommendations generated during previous call-ups. An automatic main blast detector was developed and the resulting signal processing module was shared with the Integrated Multistatic Passive Active Concept Testbed (IMPACT). A dedicated clutter image analysis application was generated in STAR and an Energy Time Indicator (ETI) analysis application was integrated with it to allow simultaneous image and ETI analysis. Data from TMAST02 Run 18 was processed and initial analysis was performed to generate an initial utility assessment and ideas for further work.

Résumé

Le présent rapport documente le travail effectué en vue d'aider à la production et à l'analyse des images de clutter dérivées des passages 11 et 18 de TMAST02. Ce travail consistait à apporter de petites améliorations à la suite d'outils logiciels d'analyse et de recherche (STAR) basée sur le langage IDL (Interactive Data Language) en se fondant sur les recommandations exprimées en réponse aux demandes précédentes. Un détecteur d'explosion initiale principale automatisé a été développé et le module de traitement des signaux résultant a été partagé avec le banc d'essai multistatique intégré actif/passif (IMPACT). Une application d'image de clutter spécialisé a été générée dans STAR et une application d'analyse sur indicateur d'énergie-temps (ETI) lui a été intégrée afin de permettre l'analyse simultanée par image et par ETI. Les données du passage 18 de TMAST02 ont été traitées et l'analyse initiale a été effectuée pour générer une évaluation initiale de l'utilité et des idées pour les travaux suivants.

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Executive summary

Introduction

The objective of this call-up was to provide the necessary software enhancements, data processing and analysis to determine the utility of clutter images for multistatic frequency modulated (FM) target detection and tracking in a high-clutter environment. Secondary objectives were to improve the general utility of the clutter image plot modules and to implement an automatic main blast detector in STAR.

The idea of clutter images was conceived during the TMAST02 trial, where it was difficult to find the target amidst considerable target-like clutter returns. One significant difference between target and clutter is motion; however, motion is not apparent in a typical ETI display. It was hypothesized that if a series of ETIs were stacked (as power spectra in a GRAM display), the resulting image would provide more information than a simple ETI. In addition, the clutter image could reduce operator scan rate requirements by retaining history on the display, and thus, help reduce the operator overload.

Results

Due to the STAR software enhancements from this call-up, an operator can create GRAM-like clutter images once the main blasts have been detected. Navigation tools were developed so that the clutter image display can be zoomed in or out of, assisting in target detection. Another tool provides the ability to select a point off the clutter display (e.g., from a target-like return) from which a multi-ping ETI display is spawned, allowing for focused in-depth analysis. In addition, an automatic main blast detector was developed and the resulting signal processing module was shared with the Integrated Multistatic Passive Active Concept Testbed (IMPACT).

Significance of Results

This contract showed that having the ability to view clutter images for a given receiver and beam is useful in both reducing false alarms and increasing detection performance. Here, data from TMAST 02 Run 18 was converted to clutter images for preliminary analysis. Many of the returns that were target-like on the conventional ETI display were immediately recognizable as geo-clutter in the images. In addition, some valid target echoes were found in this challenging environment, improving on the dismal in-flight detection. These results provide a preliminary indication that these tools would be a beneficial addition in a Group IV MVASP upgrade.

Future Work

A section of this report is dedicated to recommendations for future work, including determining contact motion from the clutter display, providing a clutter selection cueing on the ETI display, improving the main blast detector, addressing the problem of unevenly spaced pings, and improving the data navigation dialogue.

Sommaire

Introduction

L'objectif de cette demande était d'apporter les améliorations logicielles nécessaires et d'effectuer le traitement et l'analyse des données afin de déterminer l'utilité des images de clutter pour la détection et le suivi multistatiques d'objectifs avec modulation de fréquence (FM) dans un environnement produisant un clutter important. Les objectifs secondaires consistaient à améliorer l'utilité générale des modules de traçage de l'image de clutter et de mettre en oeuvre un détecteur d'impulsion initiale principale automatisé dans la suite logicielle STAR.

L'idée de recourir aux images de clutter a pris naissance au cours des essais TMAST02, au cours desquels il était difficile de trouver l'objectif parmi un nombre considérable d'échos de fouillis similaires à cet objectif. Le mouvement est une des principales différences entre le clutter et les objectifs, mais il n'est pas apparent dans un affichage ETI représentatif. On a émis l'hypothèse selon laquelle, si on empilait une série d'affichages ETI (comme spectre de puissance dans un affichage GRAM), l'image résultante fournirait plus d'information qu'un simple ETI. De plus, l'image de clutter réduirait les besoins de l'opérateur en matière de fréquence de balayage en retenant l'historique sur l'affichage et, par conséquent, aiderait à réduire la surcharge de l'opérateur.

Résultats

Grâce aux améliorations apportées au logiciel STAR à partir de ces appels de commentaires, un opérateur peut créer des images de clutter de type GRAM lorsque les principales impulsions initiales ont été détectées. Des outils de navigation ont été développés de manière à ce qu'on puisse agrandir ou rapetisser l'image de clutter, ce qui peut aider à la détection des objectifs. Un autre outil donne la capacité de sélectionner un point de l'affichage du clutter (p. ex. d'un écho semblable à une cible) à partir duquel un affichage ETI de plusieurs impulsions est généré, afin de permettre une analyse ciblée approfondie. De plus, un détecteur d'impulsion initiale principale automatisé a été développé et le module de traitement des signaux résultant a été partagé avec le banc d'essai multistatique intégré actif/passif (IMPACT).

Importance des résultats

Ce contrat a permis de démontrer que le fait de disposer de la capacité de voir les images de clutter correspondant à un récepteur et à un faisceau donnés est utile pour réduire le taux de fausses alarmes et d'améliorer les performances sur le plan de la détection. Dans ce cas, des données du passage 18 de TMAST 02 ont été converties en images de clutter en vue d'une analyse préliminaire. De nombreux échos qui ressemblaient à des objectifs sur un affichage ETI classique étaient immédiatement reconnus comme images de géoclutter dans les images. De plus, certains échos d'objectifs valides ont été détectés dans cet environnement difficile, ce qui améliore la performance de détection médiocre pendant ce passage de l'essai. Ces résultats

représentent une indication préliminaire à l'effet que ces outils constitueraient un ajout utile lors d'une mise à jour du groupe IV du MVASP.

TRAVAUX À VENIR

Une section du présent rapport porte sur des recommandations au sujet de travaux à venir, y compris la détermination du mouvement des contacts à partir de l'affichage de clutter, le repérage de sélection du clutter sur l'affichage ETI, l'amélioration du détecteur d'impulsion initiale principale, la résolution de l'espace inégal entre impulsions et amélioration du dialogue de navigation dans les données.

Hood, J and C Macmichael. 2005. STAR Clutter Analysis and Enhancements Final Report. DRDC Atlantic CR 2005-098, Defence R&D Canada - Atlantic.

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1. Introduction

This final report outlines the work done under Noise Monitoring Software Regional Individual Standing Offer (RISO) W7707-032293/001/HAL, Call-up Requisition No. W7707-04-2626. This work was performed for Defence R&D Canada (DRDC) - Atlantic under the direction of the Scientific Authority (SA), Nicole Collison, from approximately September 2004 to January 2005.

1.1 Overview

The objective of this call-up was to provide the necessary software enhancements, data processing and analysis to determine the utility of clutter images for multistatic Frequency Modulated (FM) target detection and tracking in a high-clutter environment. A secondary objective was to improve the general utility of the power spectra / clutter image plot modules in STAR.

The idea of clutter images was conceived during the TMAST02 trial. During this trial it was difficult to find the target amidst considerable target-like clutter returns. One significant difference between the target and clutter is motion, however, motion is not apparent when looking at a typical ETI display. It was hypothesized that if a series of multistatic ETIs were stacked, as power spectra are stacked to generate a GRAM display, the resulting image would be more intuitive to interpret and provide more information than a simple ETI. It was also hypothesized that the resulting "Clutter Image" would reduce operator scan rate requirements by retaining history on the compressed display. Because of the longer history, the speed at which an operator must scan the data would be reduced.

The initial contract showed that target motion can look significantly different than a stationary target and improve detectability in a low clutter environment. In addition to software enhancements, this contract was to facilitate analysis of target data in a high clutter environment.

This call-up was also significant in the way that it approached development of a main blast detector. (The automatic main blast detector was developed to remove the requirement for an analyst to hand-select each main blast prior to clutter image creation.) A previously developed main blast detection algorithm was selected from IMPACT. Then via development of a Signal Processing Library (SPLIB) module and a Signal Processing Package (SPPACS) wrapper, the automatic main blast detector was developed for this contract. Once there was an independent module running on a Personal Computer (PC), common tools such as IDL and Matlab were used to model, test and improve the algorithm. The improvements to the SPLIB module were then provided back to the IMPACT team.

This report is broken into six main sections. The remainder of this section provides background on the software used during the call-up. Section 2 provides an overview of the call-up's software development requirements and work performed to meet those requirements. Section 3 documents the data analysis and unclassified results and recommendations. Section 4 documents ideas for future work that were generated during the call-up. Section 5 details software configuration management processes and the versions used for this call-up. Section 6 provides a summary of current software issues.

1.2   Background

The data processing and analysis work was performed using two software suites: STAR and SPPACS. An overview of the two software suites is provided in the following subsections.

The STAR and SPPACS suites are configuration controlled using the concurrent versioning system (CVS), and issue and enhancement idea tracking is affected using the Bugzilla issue tracking software. CVS is a repository that allows developers to check-in revisions to software and documentation where they are archived in a common database. The tool allows all previous versions of the software to be maintained and aids resolution of new issues, while ensuring that current builds of the software are readily accessible to users and developers alike. Bugzilla is a web accessible database that offers both user and developer input to issues, priorities and solutions. It provides coherent tracking and recording of an issue over its entire lifecycle.

STAR and SPPACS components are documented in a combination of formats, each with their own purpose. Microsoft Word documents are maintained, which describe functionality and algorithms of components. These are primarily intended for the end user. Enterprise Architect (EA) files are maintained, which document software design, interaction and dependencies. EA design information is intended primarily for developers. Hypertext Markup Language (HTML) library documentation is being developed that provides automatic extraction of the routine's Application Program Interface (API), purpose and description. This documentation is maintained to assist developers in familiarizing themselves with the existing libraries and components, and is intended to support and encourage software reuse. Some users may also wish to refer to this information for use in their own custom applications. SPPACS also provides HTML and main page user documentation for each module.

The most current status of the SPPACS and STAR suites can be found at https://star.iotek.ns.ca. Users are also encouraged to refer to the electronic documentation provided with the software distribution for up-to-date information.

1.2.1 STAR

The STAR suite was developed to support general research and analysis objectives at DRDC Atlantic. The primary objectives of the STAR suite are:

- Provide scientific grade analysis tools that allow for efficient, detailed quantitative and qualitative analysis of a data set.

- Support synergy between DRDC groups and the Department of National Defence (DND) by providing a common software base for analysis. This synergy encourages inter-group communication and simplifies user training, analysis process development, documentation and data portability.

- Support cost and analysis efficiency by providing software reuse and common tools and data formats. Examples of efficiency would be using the output of analysis from one group to feed the inputs of another, or using common software components to lower development cost of several custom analysis tools.

All STAR components are currently implemented using IDL, though the design is not restricted to IDL. The name STAR reflects the generic nature of the software. Applications in the STAR suite are built using a combination of reusable and custom components that meet the requirements of each application. The layered design and common components allow for rapid and logical development of new capabilities. Though currently focused on sonar data processing and analysis, the tools are capable of expanding to meet other analysis and research requirements.

1.2.2 SPPACS

SPPACS is a group of software programs that are based on the C programming language and is implemented on Linux-based PCs. Each program provides a specific processing function and a series of programs can be chained together to create a custom-processing stream using the command line or scripts. The output from SPPACS is stored in DREA formatted data files. SPPACS has slowly evolved to its present day state due to the efforts of several MacDonald Dettwiler and Associates Ltd. (MDA) personnel over the last 4 years.

SPPACS has been used to perform a number of mid-trial and post-trial processing functions, such as the post-trial study of multistatic trial data and the mid-trial analysis of the Q265 sonobuoy test trial. SPPACS only performs data manipulation and does not provide an interface to examine the results. The processed data output is often imported into other applications that enable data display and are used to perform the detailed analysis of the results. One example of such an application is the STAR suite.

The SPPACS software suite consists of two types of software. One type is runtime executables that can be used to process DRDC Atlantic data files in a number of ways, including data management and signal processing. Each program performs a specific function and the programs are designed so that they can be used in conjunction to perform more complex processing tasks. The software has proven to be very useful in

simplifying data management and sonar processing tasks by providing a set of tools from which to build the necessary processing streams. These streams can be run from the command line or assembled into scripts to perform batch-processing tasks allowing for large amounts of data to be automatically processed. The second form of the software is a group of library functions that can be used by other programs to efficiently perform standard tasks. These library functions are extensively used by the runtime software, but can also used for other applications. There are now three types of libraries. The first are utility routines for performing tasks, such as header manipulation and command line parsing. The second are signal processing modules termed SPLIB. These are low-level modules, each performing a low level signal-processing task. A new SPPACS module typically consists of one or more SPLIB modules linked together with an SPPACS user interface. The final library type is a sonar processing module termed sonar library (SONLIB). These are more complex modules that combine several SPLIB modules to create a complex sonar module, such as passive processing. Separating the SPLIB and SONLIB modules from SPPACS generated more generically reusable software. SPLIB and SONLIB are independent of the data header format, timestamping method, etc. and are suitable for integration in real-time processing systems.

SPPACS is also supported by a set of signal processing libraries known at the Fastest Fourier Transform in the West (FFTW). These free, open-source libraries provide optimized signal processing functions helping to ensure that the SPPACS software runs as efficiently as possible, while providing a significant reduction in coding effort.

2.   Development Work Overview

This section presents an overview of the tasked and completed work. The development requirements for this call-up are listed in Table 1 while the remainder of this section indicates how each requirement was met.

A detailed description of the technical aspects related to the work performed under this contract can be found in the primary STAR reference, "The Software Tools for Analysis and Research Data Analysis and Technical Manual - Revision 1" [R-1]. This document is located at (/usr/local/atools/acoustics/src/analysis_tools/ documents/STAR_analysis_technical_manual.doc). This document provides details, such as the algorithms used to perform the various analysis measurements, and recommends a complete analysis process that can offer significant improvements in efficiency to DRDC Atlantic. Each complex program (i.e. ETI analysis, power spectra analysis display, automatic reanalysis, etc) is started using a script. These scripts provide a quick and easy way of launching the analysis applications. See "The Software Tools for Analysis and Research Data Analysis and Technical Manual - Revision 1" Section 7.6 [R-1] for more information on how to use and customize these scripts.

Table 1. Contract Requirements

REQUIREMENT TITLE	ASSOCIATED REQUIREMENTS
Clutter Image Generation	• The contractor shall upgrade the clutter image generation module to work with the new main blast query results structure. • The contractor shall upgrade the clutter image generation module to create an auxiliary data file that contains the mapping of ping number to start time for that file and if required, contains the name of the raw data file.
Clutter Image Display and Navigation	• The contractor shall modify the clutter image display to allow navigation by bin on a selected window of data (bin is time from start of scan). • The contractor shall complete the implementation of a slice display that shows cross sections of a clutter image in the original ETI analysis display. The slice display shall be a synchronized display that draws information from a raw (unnormalized) ETI data file. • When a user selects a point on the clutter image that ping shall be used to generate the middle image of a multi-ping plot. For even numbered plots there shall be one less ping before.

Table 1. Contract Requirements

REQUIREMENT TITLE	ASSOCIATED REQUIREMENTS

ETI Measurement	• The contractor shall enhance the ETI display to allow a user to select a main blast, false alarm or echo for:
	
	    o Deletion from the database. This shall also delete the entry from the source log file.
	    o Amplification of the entry in a dialog box. This shall include annotation of the log entry structure members. The annotated log entry shall also be retrofitted to the original contact confirmation dialog.

Main Blast Measurement	• The contractor shall generate an SPPACS signal processing module that automatically detects main blasts using an SA supplied algorithm and writes a STAR log file of the detected main blasts. An objective of this module is to write software that can be directly ported into the IMPACT signal processor and cross-compile to use the Synergy vector processing libraries.

The following work was completed to address the requirements listed in Table 1.

2.1 Clutter Image Generation

The clutter image generation module update mentioned in the Statement of Work (SOW) turned out not to be required as it was already completed. An auxiliary data file containing the list of main blasts used to generate the clutter file was generated. The first line of the auxiliary file is a clutter header line that contains the start time of the source data file, and the desired offset in seconds before and after the main blast that was used to generate the clutter image. All following lines used the standard main_blast_log structure. The log entries are sorted by receiver so that all scan lines for a single receiver are grouped together, and in the order that they were written to the file.

2.2 Clutter Image Display and Navigation

A clutter image display application was created to load a clutter file into a GRAM like display. The application then uses the auxiliary file, associated with the clutter file, to initialize an ETI window displaying the raw ETI data for the first receiver.

The user may select a point on the clutter display, which represents a single ping. The selected ping will then be used to update the ETI display to display the main blasts before and after the selected ping.

Figure 1. Data Navigation Dialog

The navigation toolbar shown in Figure 1 was updated to support bin navigation within the clutter display window. Bin navigation in this case allows the user to display a segment of the clutter image, in time since the main blast, and pan in time. (Normally a bin would be a frequency cell from a GRAM display, but as it turns out the same processed file and display format works well for Clutter Images, hence the terminology.)

The bin_length (amount of time displayed) and bin_step (amount of time to step) may be configured from the display properties dialogue box. At this point bin_length and bin_step are integers. In time, they should be modified to be a time in seconds.

The user may modify any of the fields in the second row of Figure 1 and click the "set" button to update the display with data for the entered values. The values set in this row are used to update the first display panel. The matching values for the remaining panels depend on the display alignment set inside the display navigation properties dialogue.

2.3 ETI Measurement

The ETI display was updated to provide additional annotation in the contact confirmation dialog when main blasts, echoes, false alarms, or other objects are generated within the window. The annotation is used to indicate the name of each value in a log entry as shown in Figure 2. It is also possible to retrieve and selectively delete log entries by pressing the 'g' hotkey and then clicking on annotation in an ETI display panel. The closest log element is always selected whether or not it is on the display. Selection displays the annotated details dialog for the object, and provides the option to delete the object from the database and from the source log file.
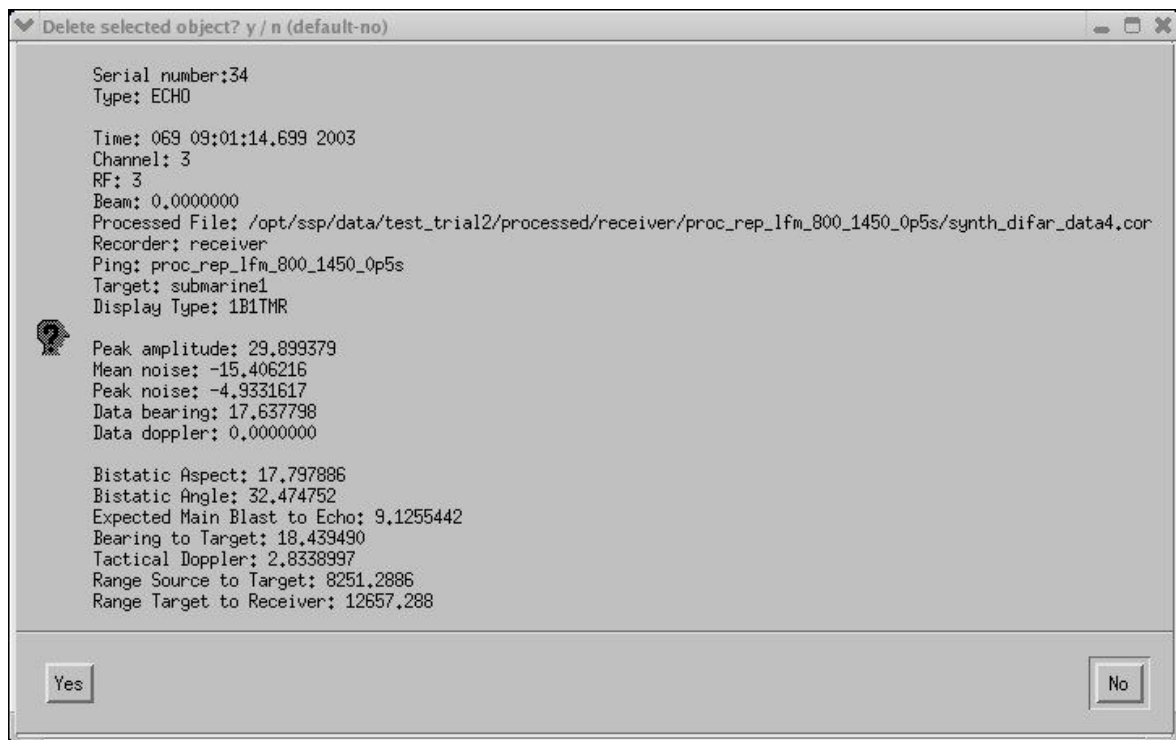
Figure 2. Annotated Log Output

2.4 Main Blast Measurement

An SPPACS signal processing module was created that automatically detects main blasts and writes a STAR log file of the detected main blasts. The log file can then be used to generate a clutter annotation file for use with the clutter display. The signal-processing component of the main blast detector was developed in an SPLIB module to ensure portability to systems like IMPACT. The SPLIB module contains compile time options to replace some vector processing functionality with optimized calls to Synergy's library. Synergy's library is used on IMPACT. Some of the module development was done as part of the IMPACT contract and the module was installed in IMPACT for testing, which was successful.

A flaw in the main blast detector algorithm was found and mitigated during this contract. The original main blast detector was used in IMPACT to detect incoming impulsive signals. The onset of these signals is very rapid, creating an almost square leading edge. However, the main blast detector was also required for FM signals, whose onset in a correlation time series can be much slower. During testing and analysis in Matlab, it was found that the normalized peak used to mark a detection always occurred before the actual main blast. The algorithm was then modified to search the un-normalized correlated data in the region of the peak to find the actual main blast peak. This type of testing would not have been feasible using software developed solely for a system such as IMPACT.

The SPLIB design is more structured and object-oriented than the remaining IMPACT code, so some ramp-up time is expected as developers transition to this design. Once trained, code can be developed at approximately the same rate and software re-use is much higher. Considering that many processing modules have been developed and tested in SONLIB and SPLIB, with more under development, it may be worthwhile to consider transitioning IMPACT to this design and development approach.

3. Data Processing and Analysis

This section outlines the data processing and analysis that was performed as part of this call-up. The data processed for this call-up is classified, so only high-level information will be provided. No formal analysis results were provided as part of this call-up though substantial time was spent reviewing the clutter images and adjusting both the displays and signal processing with the SA.

TMAST02 Run 18 was selected for primary analysis. The following processing and data preparation was performed on the data from this run:

- The SA transformed the trial Non-Acoustic Data (NAD) to STAR format.

- The SA copied the IMPACT Digital Linear Tape (DLT) data to the analysis system, Whale, with contractor assistance.

- Each data file was processed for the selected ping to create beamformed correlation time series data.

- The main blast detector was run on the data with default settings. After the run it was found that some of the detected main blasts were false, while others were missed. The SA and MDA worked together to understand and refine the main blast algorithm and improve performance. Once this was done, as best possible given the contract funding, the SA viewed and adjusted the main blasts using STAR.

- MDA then generated some clutter image files using STAR. The resulting clutter image files were also passed through the SPPACS median normalizer to improve their display quality and contact detectability.

4. Recommendations for Future Work

During the contract a number of ideas were generated that could prove beneficial to investigate and expand upon. Those ideas are documented in this section.

4.1   Provide a Tactical Decision Aid

A number of potential contacts were found during initial analysis, but it became difficult to be certain that the apparent target motion was valid. The multistatic nature of the data and the fact that the source and receivers were in motion, created a very busy clutter display with some clutter points moving closer, while others moved away with many different rates. Regardless a clutter point still must be stationary or be a glint moving with the source / receiver motion along a prominent ridge. It should be possible to determine if a clutter point's movement over a sequence of pings could possibly be due to a stationary target, or if it must be in motion.

It would be possible to provide a tool where the operator begins by selecting several points in the clutter image that correspond to the same clutter point. The computer would then determine if that point is in motion or if the image is from a stationary point. The computer would analyze the source and receiver motion to determine the range of potential tracking rates around the corresponding ellipse or along a sector of the ellipse corresponding to a contact bearing. These tracking rates would then be compared to the clutter point's rate of change to help assess contact motion.

4.2   Provide Clutter Selection Cueing on the ETI Display

The clutter image proved to be a good display for finding potential contact. One of the steps in assessing contact was to select the clutter point and have STAR recreate a set of ETI displays corresponding to the pings in that time range for that receiver and beam. It became difficult to be sure of which peaks in the ETI display corresponded to the selected clutter point. The ETI display should have an overlay that shows the selected time for operator reference.

4.3   Improve Main Blast Detection

During analysis of the automatic main blast detection output, it was found that in some cases pings from other sources were detected as main blasts. This required a higher than desirable threshold to avoid this problem and caused some valid main blasts to be missed. An operator pass on the data was required to fix some of these issues prior to clutter image generation. Though vetting the detected main blasts was much faster than performing the complete task manually, improvements are desirable.

Main blast detection performance could be improved by pre-filtering the data to remove out-of-band noise. It may also be improved by making the detector more complicated to help it reject the more rounded interference reverberation that lacked a distinct correlation peak.

4.4 Deal with Unevenly Spaced Pings

Clutter images are built assuming evenly spaced pings. In some cases pings are missed on a receiver due to interference. In an operational scenario the search ping rate may not be periodic. Both cases cause gaps in the data. It should be possible to interpolate or resample the clutter images to provide an image that is evenly spaced in time rather than add a new scan line for each ping, regardless of the time spacing between pings.

4.5 Improve Data Navigation Dialogue

Though relatively minor, the "Data Navigation Dialogue" should be changed to allow the user to specify step and duration in seconds rather than "bins". This issue is discussed in section 2.2.

5. Maintain Configuration Management

STAR and SPPACS are maintained using CVS. The most recent release version is maintained and bug fixes are applied to that version, as required, ensuring that a stable release is always available. Simultaneously, software enhancements are applied to the development version and bug fixes are merged with this version. Once a call-up nears completion, or a release of the software is otherwise required, a new release version is branched off of the development stream for final integration, release testing and delivery.

STAR (includes SPPACS) release 4.5.1 (tag star_release_4_5_1) was created under this contract to serve as a baseline while the analysis work was being conducted. This allows development to continue on the trunk of the distribution. The trunk usually contains newly implemented software, which may not be stable enough to allow for operational use.

6. Track Software Issues

Defect tracking systems allow users to effectively keep track of outstanding bugs in their product. STAR and SPPACS issue tracking is performed using a web accessible tool called Bugzilla. This tool can be accessed using a secure web interface at https://star.iotek.ns.ca. Once the appropriate security procedures, detailed on the web page, have been followed, users and developers can use this site to add, view or modify issues related to the software packages.

A breakdown of the current issues for the STAR and SPPACS distributions are shown in Table 2. The total number of unresolved issues is shown in the NEW/ASSIGNED/ REOPENED column. The total number of opened issues is broken into two classes of severity. Issues classified as BLOCKER/CRITICAL/MAJOR are issues that should be addressed in the short term. Blockers are always addressed immediately to ensure that the user community can continue with their work. Issues classified as NORMAL/ MINOR/TRIVIAL are issues that can be dealt with in the long term.

Table 2. Distribution Issue Summary (21/12/2004)

PRODUCT	NEW/ASSIGNED/ REOPENED (TOTAL)	BLOCKER/CRITICAL/ MAJOR	NORMAL/MINOR/ TRIVIAL
SPPACS	34	1	33
STAR	52	3	49

The following gives a more detailed description of the SPPACS BLOCKER/ CRITICAL/MAJOR column:

- Issue # 284 (major) fails DAT32 byteswap case. The utility is attempting to read the extra gains using the original header, which may be in a different byte-order than the platform.

The following list gives a more detailed description of the STAR BLOCKER/ CRITICAL/MAJOR column:

- Issue # 193 (critical) tacplot does not cleanup before exiting. The workaround for this issue is to run heap_gc after the analysis window has closed.

- Issue # 107 (major) problems capturing close button. A solution exists for this but has only been incorporated into the tactical plot. The exit button provides application termination capability.

- Issue # 295 (major) capture screen doesn't work correctly. The Capture Screen button does a screen capture on the analysis window and not the tactical plot. Taking a screen capture immediately after opening the window can solve this problem. A fix has been implemented and will be released with the next version.

7. References

1. The Software Tools for Analysis and Research Data Analysis and Technical Manual –
   Revision 1, (Whale: /usr/local/atools/acoustics/src/analysis_tools/documents/
   STAR_analysis_technical_manual.doc) STAR Release 4.5.1

List of symbols/abbreviations/acronyms/initialisms

API	Application Program Interface
CVS	Concurrent Versioning System
DLT	Digital Linear Tape
DND	Department of National Defence
DRDC	Defence R&D Canada
DREA	Defence Research Establishment Atlantic
DRP	Document Review Panel
EA	Enterprise Architect
ETI	Energy Time Indicator
FFTW	Fastest Fourier Transform in the West
FM	Frequency Modulated
HTML	Hypertext Markup Language
IDL	Interactive Data Language
IMPACT	Integrated Multistatic Passive/Active Concept Testbed
MDA	MacDonald Dettwiler and Associates Ltd.
NAD	Non-Acoustic Data
PC	Personal Computer
RISO	Regional Individual Standing Offer
SA	Scientific Authority
SONLIB	Sonar Library

SOW	Statement of Work
SPLIB	Signal Processing library
SPPACS	Signal Processing Package
STAR	Software Tools for Analysis and Research

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This report documents the work done to aid in the generation and analysis of clutter images derived from Run 11 and Run 18 of TMAST02. This work included providing small enhancements to the existing Interactive Data Language (IDL)-based Software Tools for Analysis and Research (STAR) software, based on recommendations generated during previous call-ups. An automatic main blast detector was developed and the resulting signal processing module was shared with the Integrated Multistatic Passive Active Concept Testbed (IMPACT). A dedicated clutter image analysis application was generated in STAR and an Energy Time Indicator (ETI) analysis application was integrated with it to allow simultaneous image and ETI analysis. Data from TMAST02 Run 18 was processed and initial analysis was performed to generate an initial utility assessment and ideas for further work.

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Software Tools for Analysis and Research (STAR), TMAST02, clutter, multistatic, frequency modulated

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